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RESEARCH OF HEAT RATES EFFECT ON THE PROCESS OF FUEL-BED GASIFICATION OF "BALAKHTINSKOE", "OSINNIKOVSKOE", "KRASNOGORSKOE" AND "BORODINSKOE" COAL DEPOSITS

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Abstract. Experimental research of fuel-bed gasification at different heating rates was conducted. Release of four gases (CO, NO, H_2O, CO_2) was determined. Optimal heating rate mode for this method of gasification was established.

1 Introduction

It is known [1], that almost all the coal mined in Russia is used in production of energy by direct combustion in thermal power plants; only 15% is used in metallurgy and 5% in chemical industry [1].

In order to implement the directive №2008/1/EC three directions of efficient use of energy resources are identified in Russia:

- gasification to produce synthesis gas, hydrogen and other reducing gases for chemical industry;
- gasification of low-rank coals, followed by burning of the treated gas at thermal power plants;
- production of natural gas substitute used in industrial, energy and domestic sectors of the economy [1].

Research of gas intensification processes from coal pyrolysis in a dense layer was performed by simultaneous thermal analysis method using Netzsch STA 449 F3 Jupiter and QMS 403 D Aeolos [1-2].

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2 Experimental setup

In the preliminary phase of study of initial fuels gasification their elemental analysis was determined using a scanning electron microscope (SEM) JEOL JCM-6000 [1-4]. Preparation of the samples was carried out in accordance with GOST 10742-71, followed by sieving in accordance with GOST 3306-88. Particle size of the test powder was less than 80 microns. Performed chemical analysis of initial coal samples allowed obtaining elemental composition of raw material (Table 1).

Table 1. Elemental composition of raw material.

Element	Composition of element, mass.%			
	Anthracite	Bituminous coal	Brown coal	
	A	T	2B	3B
C	82.14	71.05	65.99	82.65
N	11.26	-	12.55	13.70
O	4.04	19.26	14.25	0.06
Al	0.51	2.02	0.84	0.33
Si	1.36	3.04	2.72	0.29
S	0.08	0.42	0.16	0.17
Ca	0.61	2.63	1.84	2.30
K	-	0.59	0.40	0.04
Fe	-	0.56	1.25	0.46
Na	-	0.03	-	-
Mg	-	0.13	-	-
Ti	-	0.09	-	-
Zr	-	0.18	-	-

Relying on the obtained research results, output of gases that should be recorded in mass-spectrometer during experiments on modeling of fuel-bed gasification was predicted [3-4].

Prepared samples with weight of twenty milligrams were analyzed at different heating rates of 278, 283, 293, 303 K/min. Argon consumption for blowdown was 10 ml/min, air consumption – 50 ml/min. Maximum heating temperature was 1573 K.

3 Results

A series of experiments was performed and dependences of changes of produced synthesis gas recorded mass from time were obtained. Relative area is the ratio of certain integral summation area to weight of coal sample minus the ash residue. The results of the synthesis gas studies are shown in figure 1.

Relative integrand area of gases release A, heating rate B [1].

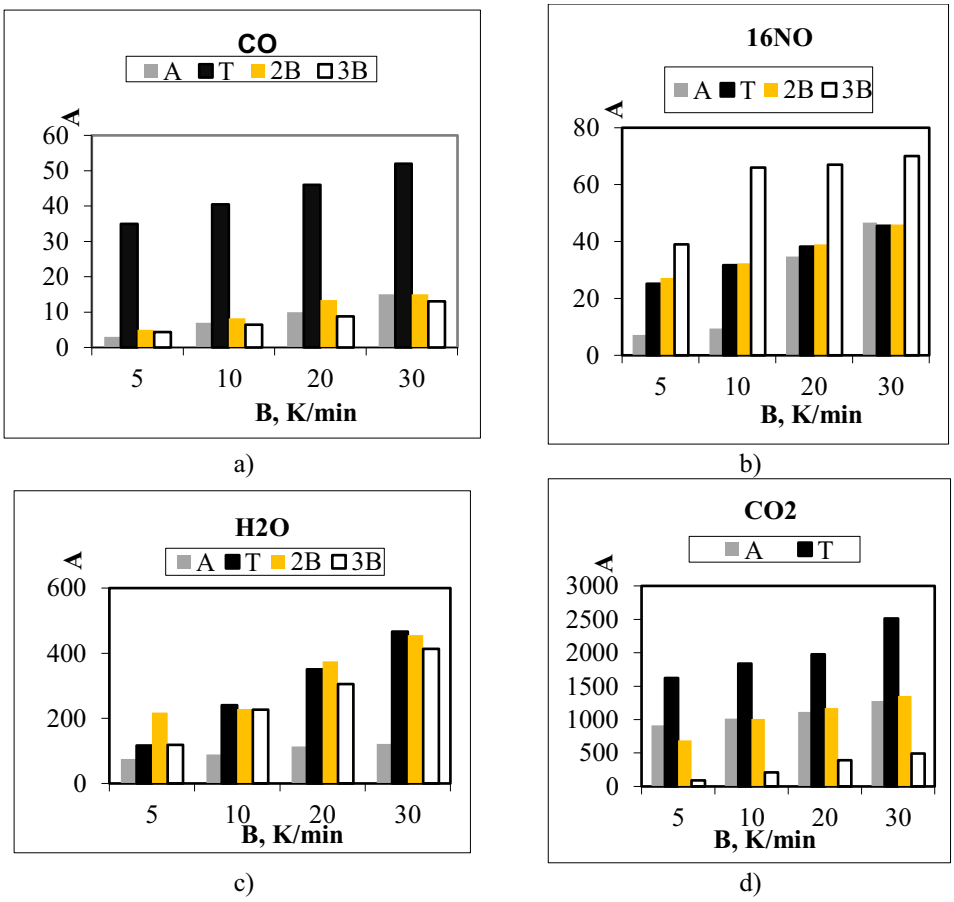

Fig. 1. Release of gases at respective heating rate (a - carbon monoxide, b - nitrogen monoxide, c - water vapor, d - carbon dioxide).

Analysis of the results presented in figure 1 shows that combustible gases CO, NO, H_2O, CO_2 produced at heating rate of 30 K/min have the highest intensification of emission for all grades of coal. Gases emission is lower at other heating rates. figure 1 shows that with an increase of heating rate intensification of gas increases.

These phenomena are explained by the fact that the process of thermal degradation is determined by the simultaneous occurrence of a whole range of consequential-parallel reactions with different activation energies and kinetic parameters.

It should be noted that the influence of heating rate appears as formation of volatile substances.

4 Conclusion

Studies on modeling of raw coal samples fuel-bed gasification allowed determining composition of gases (CO, 16NO, H2O, CO2). It was established that optimal heating rate

mode for this method of gasification is 30 K/min. Thus, there is a maximum emission of gas suitable for the future technological applications.

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